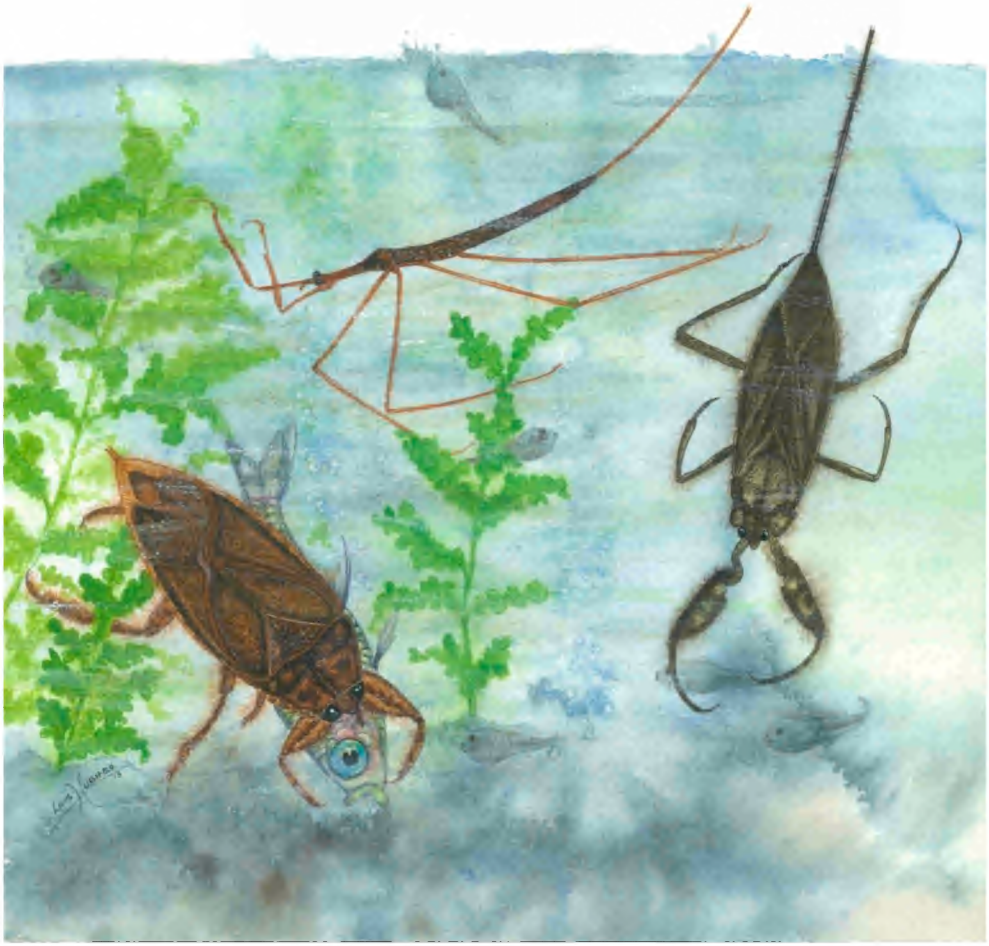

Underwater predators - left: Giant water bug (Belostomatidae), top: Needle bug (Nepidae), and right: Water scorpion (Nepidae)

METAMORPHOSIS

AUSTRALIA

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Planning and Organization Meetings

A quarterly meeting is scheduled in order to plan club activities and the magazine. See BOIC Programme.

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PO Box 2113, Runcorn, Queensland 4113
Membership fees are $30 for individuals, schools and organizations.

Aims of Organization

- To establish a network of people growing butterfly host plants;
- To hold information meetings about invertebrates;
- To organize excursions around the theme of invertebrates e.g. butterflies, native bees, ants, dragonflies, beetles, freshwater habitats, and others;
- To promote the conservation of the invertebrate habitat;
- To promote the keeping of invertebrates as alternative pets;
- To promote research into invertebrates;
- To encourage the construction of invertebrate friendly habitats in urban areas.

Magazine Deadlines

If you want to submit an item for publication the following deadlines apply:
March issue – February 1st June issue – May 1st
September issue – August 1st December issue – November 1st

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Cover Painting

Underwater predators - left: Giant water bug (Belostomatidae), top: Needle bug (Nepidae), and right: Water scorpion (Nepidae) – painting by Lois Hughes

From the President

Congratulations to our excursion convenor, Alisha Steward, who recently was awarded a PhD by Griffith University with the Australian Rivers Institute. Her thesis was titled: "When the river runs dry: the ecology of dry river beds". I find it impossible to summarize the detail of her work and will try to persuade her to write a small article about her findings for a future edition of *Metamorphosis*. You will find her contributions on slightly wetter areas in this edition.

We also congratulate John Moss who recently received the Redlands City Council Australia Day 2013 Environmental Award in recognition of his extensive work over many years.

A club member, who wishes to remain anonymous, has donated a sum of money to meet the membership fees of persons or groups who experience financial hardship and, as such, are unable to join the Butterfly and Other Invertebrates Club. If you are aware of any such persons or organizations, please discuss this offer with them with a view to nominating them for membership.

Each quarter, I find it difficult to adequately acknowledge the various articles produced by so many interesting writers but again: "Thank you". You will find that this edition is slightly larger. Several contributions have been held over for our June edition!

Best wishes *Ross*

In This Issue

Creature Feature - Large, predatory water bugs 4
Goliath Stick Insect : a phasmid of colour and character 9
Moths - The Weird and the Wonderful 13
Observations of aquatic, bug-eating moth fly larvae 17
Life history notes on the No-brand Grass-yellow *Eurema brigitta* 21
Getting more pixels 23
Field Notes : Major extentions to the known distribution of the Bright Purple Azure *Ogyris barnardi* 26
Book Reviews - A Guide to Australia's freshwater crayfish 32
The Moths of Victoria Vol. 4 37
Report - The day at Peter Hendry's identifying moths in the family Crambidae 37
Vale Barry Kenway 39
In a Corinda Garden - Some butterfly views 39
Letters 41
You Asked and BOIC Programme 43

Large, predatory water bugs – *Alisha Steward*

Many families in the Order Hemiptera ('bugs'), Suborder Heteroptera ('true bugs'), are aquatic, living in rivers, streams, ponds, lakes and other wetlands – and almost all aquatic bugs are predatory. This issue's creature feature focuses on two related families of aquatic Hemiptera – Belostomatidae and Nepidae (Fig. 1). Belostomatids are known as giant water bugs. Some nepids are known as water scorpions, as they have a broad, leaf-like body, and others are known as needle bugs, as they have a thin, stick-like body.

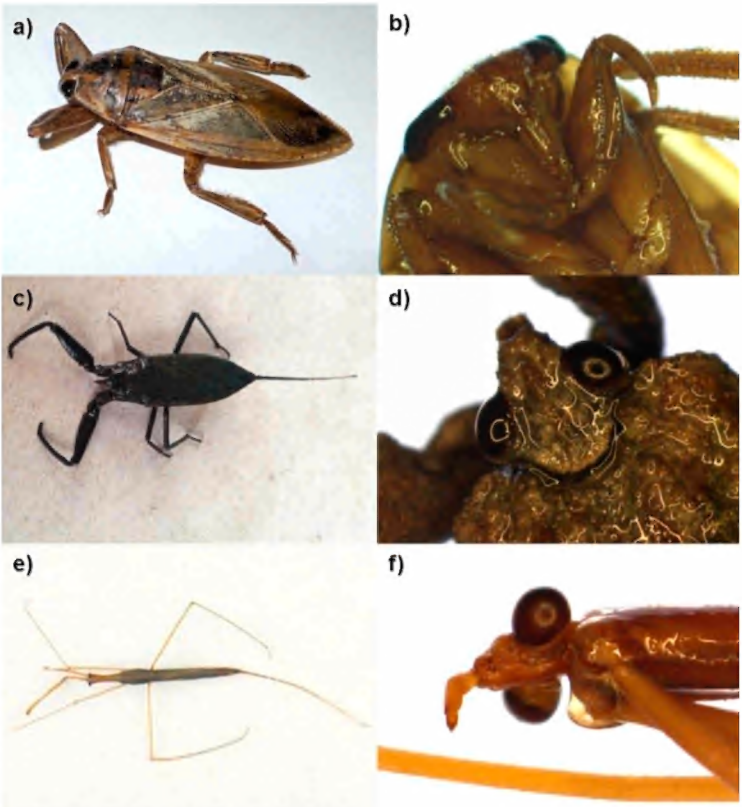

Fig. 1. Water bug body forms and their faces that only a mother could love: a) Giant water bug - *Lethocerus insulanus* (Belostomatidae), b) *Diplonychus* sp. (Belostomatidae), c) and d) water scorpion - *Laccotrephes* sp. (Nepidae), e) needle bug - *Ranatra dispar* (Nepidae), and f) needle bug (Nepidae). Photograph a) by Peter Chew (www.brisbaneinsects.com) and photograph e) by the Murray-Darling Freshwater Research Centre (www.mdfrc.org.au/bugguide/index.htm) are used with permission

Species of both belostomatids and nepids are large (15-75 mm long), and quite scary bugs at that, as they can inflict a nasty bite! They are differentiated from other aquatic bugs by their large size, the presence of raptorial forelegs (except in one African genus), and the presence of paired respiratory processes at the tip of the abdomen (Andersen and Weir, 2004). In belostomatids the respiratory processes form short, retractable 'air straps', and in nepids they typically form a long siphon.

Belostomatids and nepids spend most, if not all of their life in water, although both groups have winged adult stages capable of flying between water bodies and are quick to colonise new habitats (Gooderham and Tsyrlin, 2002). They can be attracted to lights at night, and some nepids can even end up in swimming pools! I have observed nepids in chlorinated swimming pools, presumably breathing through their respiratory siphon at the end of their abdomen - poked through the surface film and used much like a snorkel. They don't seem too fussy about water quality – on the Australian SIGNAL (Stream Invertebrate Grade Number Average Level) scale used to rate the tolerance or sensitivity of water bugs to pollution, belostomatids score 1 out of 10, meaning that they are extremely tolerant of pollution, and nepids score 3 out of 10, suggesting that they are moderately tolerant of pollution (Chessman, 2003).

Habitat and diet

Belostomatids and nepids occur throughout Australia. They prefer still or slow-moving water, and are usually found at the edge of streams or ponds where aquatic plants are present. Both types of bugs are brownish in colour and are well camouflaged amongst mud, leaves and twigs. They are typically ambush predators that sit and wait for prey. Prey includes other invertebrates, tadpoles, small frogs and even fish, all of which are captured with their forelegs. As a result of their dietary preferences, belostomatids have been found to be a nuisance in fish farms (Carver et al., 1991).

Fig. 2. Typical predatory water bug habitat in south-east Queensland – a shallow dam containing leaf litter.

In preparation for this article and its accompanying cover drawing by Lois Hughes, I visited Lois' property at Mt Cotton to look for our artist's models. The creek yielded many water bugs, but no belostomatids or nepids. Next, we visited a dam on the property, which was shallow and had a great deal of leaf litter on the bottom and around the edges (Fig. 2). A few scoops of the dip net

revealed almost a dozen water scorpions! See Fig. 3 for a photograph of some that we collected. Predatory water bugs are often the last aquatic invertebrates to be seen in drying waters, so it was no surprise to see them in this shallow dam. They prey on any remaining aquatic invertebrates, and then fly off when the water dries up. Lois kept a few of the water scorpions for observation, and in order to feed them offered them a grasshopper. The grasshopper was quickly grasped and greedily devoured.

Fig. 3. Spot the water bugs! There are two water scorpions (Nepidae: *Laccotrephes* sp.) in this photograph. Note their leaf-like appearance.

Life cycle

Males in both families can produce sound to attract females for mating, and often initiate mating by 'display-pumping' or rhythmical push-up-like body movements near the water's surface. Female belostomatids from the genus *Diplonychus* lay their eggs on the back of the male for protection (Fig. 4), whereas females of the genus *Lethocerus* lay eggs above the water on emergent vegetation that are defended by males in the water below the egg mass (Andersen and Weir, 2004). Nepid eggs possess respiratory horns, and are deposited at the water's edge or within plant tissue in a way that the horns are exposed to the air for respiration. Eggs of both families hatch into nymphs, which are similar to the adults – only smaller and usually lacking wings. Nymphs reach the adult stage in 5 moults (Gooderham and Tsyrlin, 2002).

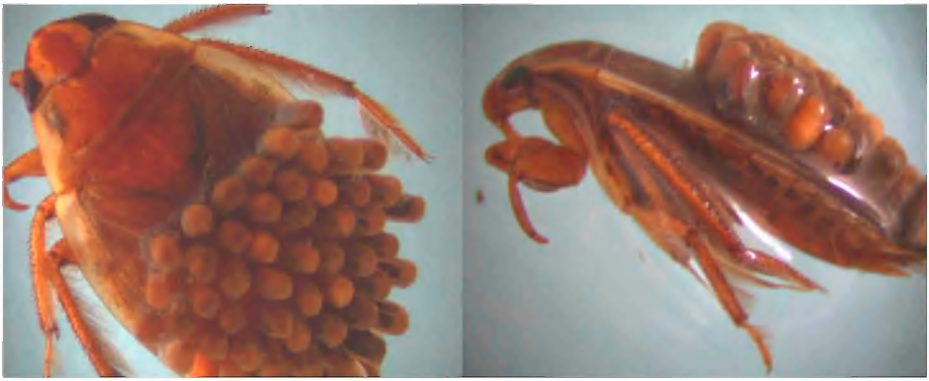

Fig. 4. Male *Diplonychus* sp. (Belostomatidae) with eggs.

Interesting facts!
I observed one of the water scorpions 'playing dead' after it was touched – it rolled over, drew its legs against its body, and stopped moving (Fig. 5). I imagine that this response is to confuse and hide from potential predators, as once they stop moving they blend in well with leaf litter and other debris.

Giant water bugs are consumed throughout many Asian countries. There are many photographs of these bugs prepared as food – usually fried – on the web. Here is a link to an example (there are many more if you search):
http://www.flickr.com/photos/cibergaita/56687803/

Fig. 5. This water scorpion (Nepidae: *Laccotrephes* sp.) appeared to 'play dead' when touched.

Conclusion
Andersen and Weir (2004) state that the biology of many Australian species is poorly known. This is in stark contrast to our knowledge of many other invertebrate groups, particularly butterflies, where we know much more about the biology of individual species (and even sub-species) – such as what plants they lay their eggs on, what time of year they are on the wing, how long the pupal stage lasts, and even information about caterpillar parasitoids. The lack of species-specific information is the reason that this article features a group of taxa, rather than one species. Aquatic Hemiptera, particularly belostomatids and nepids, are common in Australia, can be found in farm dams and backyard ponds, and can be reared in captivity, making them easy to study. These interesting water bugs are certainly worthy of more detailed research.

Classification and species checklist
Belostomatids and nepids belong to the superfamily Nepoidea. The family Belostomatidae is recognised in Australia by only 2 genera: *Diplonychus* and *Lethocerus*. The family Nepidae is represented in Australia by 5 genera – *Austronepa*, *Cercotmetus*, *Goondnomdanepa*, *Laccotrephes* and *Ranatra*. *Austronepa* and *Goondnomdanepa* are endemic to Australia.

Australian species checklist (based on Hawking et al., 2009):

Order Hemiptera
Suborder Heteroptera
Infraorder Nepomorpha
Superfamily Nepoidea

Family Belostomatidae – giant water bugs
Diplonychus eques Dufour
Diplonychus rusticus Fabricius
Lethocerus distinctifemur Menke
Lethocerus insulanus Montandon

Family Nepidae
Subfamily Nepinae – water scorpions
Laccotrephes tristis Stal
Subfamily Ranatrinae – needle bugs
Austronepa angusta Hale (endemic)
Cercotmetus brevipes Lansbury
Goondnomdanepa brittoni Lansbury (endemic)
Goondnomdanepa prominens Lansbury (endemic)
Goondnomdanepa weiri Lansbury (endemic)
Ranatra dispar Montandon
Ranatra diminuta Montandon
Ranatra ocidentalis Lansbury

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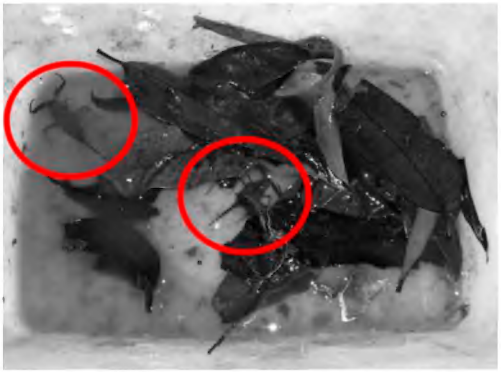
Further reading

Online identification key to distinguish between the families Belostomatidae and Nepidae (the same website can be used to identify other aquatic invertebrates) – http://www.mdfrc.org.au/bugguide/display.asp?type=4&class=17&Subclass=&Order=3&Family=&genus=&species=&couplet=14&fromcouplet=13

Peter Chew's website to insects and spiders of Brisbane, including aquatic invertebrates: www.brisbaneinsects.com



Solution to Fig. 3:

Photos, except where otherwise credited, Alisha Steward

ITEMS OF INTEREST

The Goliath Stick Insect: a phasmid of colour and character –

Densey Clyne

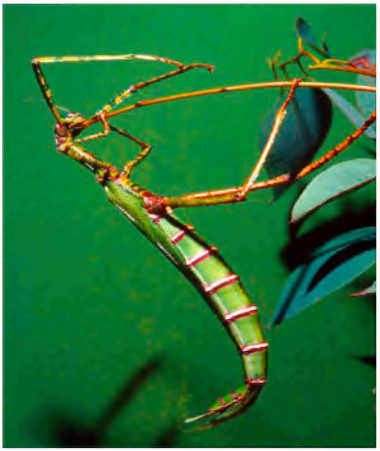
Generally speaking I don't like to keep insects in cages. Most insects need a lot of space, especially flying ones that will simply batter themselves to death trying to escape. However there are some insects that take very well to life in a cage, or even free in the house if properly fed. Phasmids for instance make rewarding house pets. They are harmless, peaceful - indeed lethargic - and easy to feed. As a bonus their droppings make convenient fertiliser pellets for indoor pot-plants.

One of my favourite 'pet' insects is the Goliath Stick insect (*Eurycnema goliath*), the most colourful Australian phasmid and one of the biggest. The bulky females can reach up to 25 cm long, but they can still be hard to locate up in the tree-tops where they prefer to feed. The young stages are brown and stick-like, and the mainly leaf-green adults while being well camouflaged among the leaves are surprisingly colourful close up.

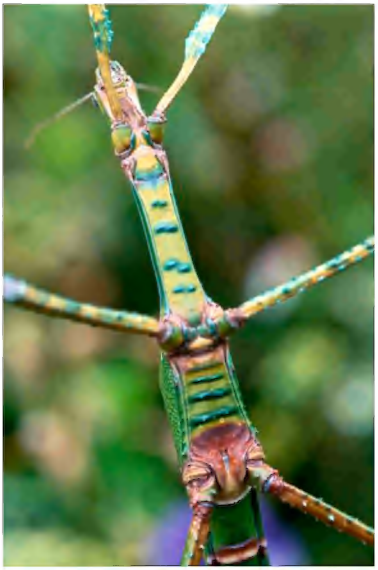
2nd instar nymph

Wings expanding after moult

Newly moulted female with exuviae



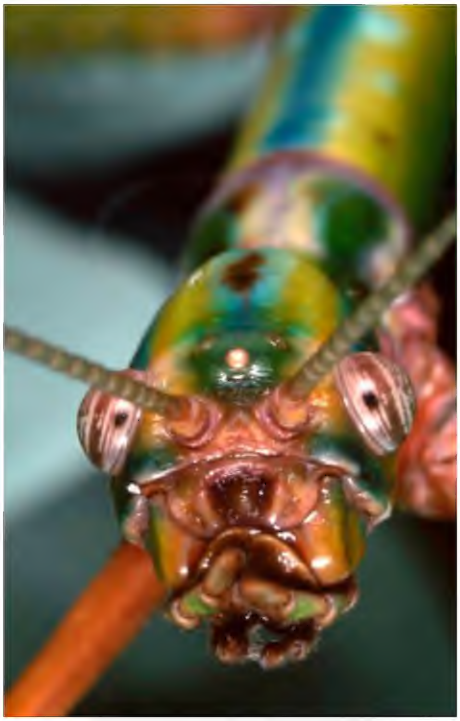
Mature female



Underside colour pattern of female

Female feeding on eucalyptus leaf

In captivity it is easy to follow and photograph the life of this charming insect, to record the colour changes through each ecdysis as the wings unfold, and to get a close look at that strange little face. But what intrigues me most is a remarkable aspect of the Goliath stick insect's biology that it shares not only with many other phasmids but surprisingly with some plants. It's a mutualistic association with ants.



Female face

Male and female mating

Many plant species have an arrangement with ants to distribute their seeds called *myrmecochory* (Gk. *myrmeco* = ant and *chory* = dispersal). The seeds of these plants have attached to them a small body called an *elaiosome* (Greek for 'oil-body') that is attractive to ants. A foraging ant will pick up a fallen seed, return home and feed this nutritious morsel to its young siblings, the ant larvae. The hard seed remains intact and is discarded or added to the ants' 'midden'. If conditions are otherwise right it will germinate and flourish there.

Now comes the phasmid connection. It involves the phenomenon of convergent evolution that occurs within both the fauna and the flora. The term is used when two unrelated organisms, often separated geographically, independently develop similar characteristics in response to similar environmental pressures. Think of hedgehogs and echidnas (spiky bristles for defence); ducks and platypuses (broad bills for foraging); mantids and mantispids (raptorial legs for predation); and of course birds, bats and insects (wings for flight). Best known among plants are American cacti and African succulents (water storage for desert survival).

There's another example of convergent evolution that I find quite amazing because it involves structures and functions that cross the borderline between flora and fauna. It relates to the dispersal of insect eggs on the one hand and plant seeds on the other, that is performed in the same way, by the same agents - ants.

The eggs of many phasmids, including the Goliath Stick insect's, actually look like seeds. They have a knoblike attachment on them called a capitulum, analogous to the elaiosome of a myrmecochorous plant. Like the seed's elaiosome, the egg's capitulum tempts a foraging ant to carry the egg into the nest. As with the seed's elaiosome the egg's capitulum is fed to the ant larvae, leaving the egg intact.

But first the eggs must get to the ground. In Image No. 9 the female's scoop-like rear appendage (the *operculum*) can be seen holding an egg in place. The *operculum* is used like a bat (or *pelota*) to toss the egg out and away from the female's own food plant. She can only toss it so far (though I've seen one throw her eggs right across my kitchen!) but then the ants take over, completing the eggs' dispersal to fresh fields.

Female operculum with egg

Goliath (*Eurycnema goliath*) eggs

The advantage? It is in the future phasmids' interests to be taken to a possibly-untouched food source. Perhaps in the female's best interests too, reducing competition for food by her offspring. Also, with aggressive ants in their vicinity the eggs may have the benefit of protection from predators and parasites. And being underground is no problem – it seems the newly hatched phasmid nymphs can dig themselves out from as deep as 6 cm. Now those vulnerable nymphs that escape attack by their former benefactors can go scurrying up into the treetops for safety!

So there's more to the Goliath stick insect than just a funny face. Her story gives us yet another reminder of the interdependence of all life on this remarkable planet of ours.

Reference

Hughes L .and Westoby M., 1992: Capitula on stick insect eggs and elaiosomes on seeds; convergent adaptations for burial by ants. *Functional Ecology 19926, 642-648*

Photos Densey Clyne

Moths -The Weird and the Wonderful - *Graham J. McDonald*

Introduction

The world of very small and unusual moths often goes unnoticed. Their interesting colours, shapes and patterns only become apparent after taking their images using a good macro lens and DSLR camera. Knowing where to look for them, how to attract them and getting to know their habits and distribution all help to make this pastime very rewarding. All the images shown here were taken using a hand-held Canon 450D DSLR camera and Canon macro f2.8 100 mm lens. All moths were live unpinned specimens with a few in their natural habitat.

Weird Moths

Fig. 2 COSMOPTERIGIDAE:
Cosmopterix heliactis
Wongi Waterholes, Maryborough - attracted to light
Wing span approx. 9 mm (Length 6 mm)
This genus contains about 10 Australian species. The tiny adults are superficially similar to each other. Larvae are leaf and stem miners of grasses and sedges.

Fig. 1 COSMOPTERIGIDAE:
Pyroderces terminella (Walk.)
Tallebudgera Creek Estuary, Gold Coast
in Casuarina glauca forest
The larvae of this moth invade deserted Polistes wasp nests. They have also been reared from larvae eating dead leaves, remains of dead insects and galled flower buds of *Acacia binervata*. They have also been found infesting the egg-sacs of the golden orb-weaver spider (*Nephila edulis*) and feeding on the eggs.
Note: There were many orb-weavers where the photo was taken.

Fig. 3 COLEOPHORIDAE:
Coleophora alcyonipennella
Mudgeeraba, Gold Coast - attracted to light
Wing span approx. 10 mm
This brilliant metallic moth is an exotic species which is naturalised in areas of Australia where the food plants are found. Larvae feed on the flowers and seeds of *Trifolium* spp. (clovers) and *Medicago* spp. (medics).

Fig. 4 TINEODIDAE:
Cenoloba obliteralis
Tallebudgera Creek Estuary, Gold Coast in mangrove community
Wing span approx. 8 mm
Moths of this family are rarely seen. They are tropical and sub-tropical in distribution. This one occurs from Innisfail, Qld to Grafton, NSW. Larvae feed in the live seeds of *Avicenna marina* (Grey Mangrove). *Cenoloba obliteralis* resembles moths of the family Pterophoridae, the plume moths which also have deeply incised wings.

Fig. 5 DEPRESSARIIDAE:
Peritornenta circulatella
North Burleigh Headland, Gold Coast on *Cupaniopsis anacardioides* (tuckeroo)
Wing span approx. 20 mm
There are six species of *Peritornenta* in Australia, all in northern areas. They are found in rainforest, soft wood scrubs and woodland. *P. circulatella* occurs in the NT and from north Qld to Ballina, NSW, inland as well as coastal. This moth resembles a damaged *Smilax* leaf and was photographed in habitat where the larvae join together leaves of *C. anacardioides.* They feed while hidden in the shelter so formed. When mature, larvae leave the shelter and pupate exposed on a leaf or other object. Pupae are also cryptically coloured.

Fig. 6 OECOPHORIDAE:
OECOPHORINAE: *Wingia psittacodes*
Pine Ridge Conservation Park, Gold Coast in dry coastal heath
Wing span approx. 22 mm
Moths of this genus usually have upturned palpi, the base of which is covered in hairy scales. They are boldly coloured in shades of orange, pink and cream and have bent wing tips. Larvae of some species tie leaves of eucalypts together with silk and hide and feed inside. This species probably ties the leaves of *Leptospermum* spp. together.

Fig. 7 AGANAIDAE: *Agape chloropyga*
Mudgeeraba, Gold Coast in planted rainforest
Wing span approx. 48 mm
This large spectacular moth is active during the day but also comes to light at night. Its ability to mimic a falling senescent yellow fig leaf protects it from predators. The moth's distribution is from Coen on Cape York Peninsula, Qld to Lismore, NSW. The larvae feed on a variety of *Ficus* spp. (fig trees).

Fig. 8 GEOMETRIDAE: GEOMETRINAE: *Uliocnemis partita*
Mudgeeraba, Gold Coast - attracted to light
Wing span 38 mm
This beautiful emerald geometrid moth lives in forest where its cryptic colours hide it from predators as it rests on lichen encrusted tree trunks. Larvae feed on *Acacia leiocalyx* (early flowering black wattle) and *Acacia disparrima* (hickory wattle). They disguise themselves with buds and flower parts of the host plant. They are pinkish brown with a dark dorsal line and have flanges along the back to which the plant parts are attached. Pupae are also covered by plant detritus.

Fig. 9 NOCTUIDAE: CATOCALINAE: *Donuca orbigera*
Wongi Waterholes, Maryborough in eucalypt woodland
Wing span approx. 55 mm
Common in tropical eucalypt woodland from Cape York Peninsula, QLD to Sydney, NSW. Its food plant and life cycle are unknown.

Fig. 10 GEOMETRIDAE: GEOMETRINAE: *Anisozyga insperata*
Mudgeeraba, Gold Coast - attracted to light
Wing span 30 mm
Another beautiful emerald geometrid from rainforest habitats.

Fig. 11 NOCTUIDAE: CATOCALINAE: *Eudocima salaminia*
Mudgeeraba, Gold Coast in moist forest types
Wing span 75 mm
The larvae of this fruit-piercing moth chew leaves of vines of the Menispermaceae family. Among these are *Stephania japonica*, *Tinospora* spp. and *Legnophora moorei*. Adult moths pierce ripe fruit and suck the sugary fluids.

Fig. 12 ARCTIIDAE: LITHOSIINAE: *Schistophleps albida*
Mudgeeraba, Gold Coast
Wing span 12 mm
This small elegant moth often flies during daylight but it is also attracted to light. It seems to be common in areas where lichens grow.

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Photos Graham McDonald

Observations of aquatic, bug-eating moth fly larvae! –

Alisha Steward

Moth flies belong to the fly family Psychodidae. The adults are sometimes also called 'drain flies' because they are often found close to sluggish or stagnant water in which their aquatic larvae live, including household drains. I see their larvae now and then in invertebrate samples from rivers and waterholes that I collect for my work as a freshwater scientist, but otherwise I have never had a close encounter with them – until recently. I discovered that Psychodidae larvae can consume dead bugs in contaminated water! Here is the story...

Occasionally, native citrus bugs (*Musgraveia sulciventris*), also known as bronze orange bugs, feed on my citrus trees. I usually tolerate them. However, in the summer of 2012/2013 they increased greatly in numbers into an infestation and were severely affecting the trees – I needed to control them. Not only do they damage citrus trees, they can also squirt nasty caustic fluid at predators, such as me, which burns the skin and can stain it yellowish-brown for days! Instead of spraying the trees with insecticide, I removed the bugs individually with tongs and dropped them into a bucket of soapy water – soapy to break the surface tension so they would sink and drown. I forgot about my haul of evil citrus bugs, and they remained in a bucket under the house for a few weeks. On discovering the rancid bucket of dead bugs, I noticed life! There was movement in the water. Moth fly larvae had colonised the bucket, and they were feeding on the dead bug bodies, apparently undeterred by the presence of washing up detergent!

Some moth fly larvae are aquatic, and are reasonably tolerant of pollution (Chessman, 2003), and some species are known to tolerate low oxygen levels and eutrophic (nutrient-rich) waters (Hawking et al. 2009). My larvae were able to survive in the soapy water of the bug bucket, although I did use biodegradable dishwashing liquid, which may have degraded during the preceding weeks. Interestingly, the water was not colonised by mosquito larvae until I topped up the bucket with rainwater. Moth fly larvae can be distinguished morphologically from other aquatic fly larvae, such as mosquito wrigglers, by having the following combination of characters: sclerotised (hardened) dorsal sections on the thorax and abdomen (Fig. 1); no prolegs; and a complete head capsule (some dipteran larvae have retractile or incomplete head capsules) (Williams, 1980, Hawking et al., 2009). The larvae I observed were less than 10 mm in length. Other features I noticed include a posterior respiratory tube (Fig. 1), and hairs covering the thorax and abdomen.

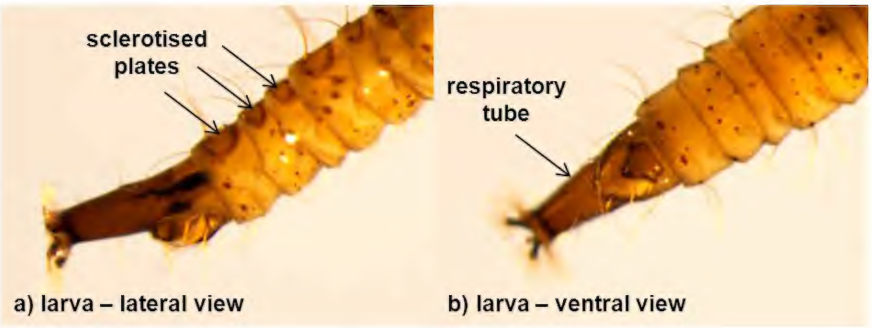

Fig. 1. Psychodidae larva

Over the following days of observation I noticed aquatic pupae in the bucket, and adult moth flies resting above the water on the sides of the bucket. The pupa I photographed had a pair of anterior respiratory horns (Fig. 2), lateral and ventral spines on its abdomen, and it did not retain the dorsal sclerotised plates characteristic of the larvae.

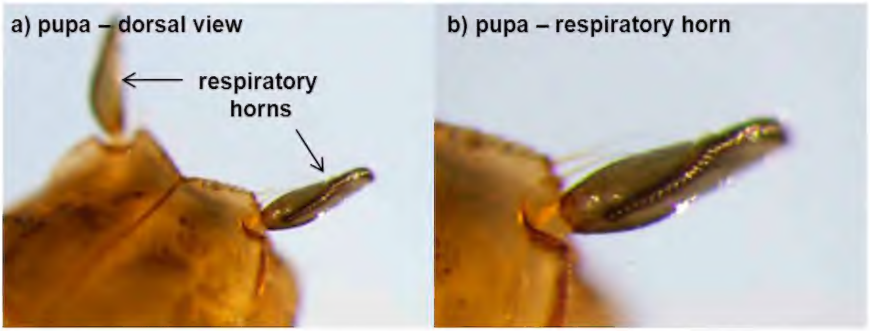

Fig. 2. Psychodidae pupa

You can see from the photographs of the grey-coloured adults (Fig. 3) that they acquired their name 'moth flies' from the fluffy appearance of their heads, wings, and bodies. I think that they are quite cute little flies! They weren't easily disturbed, and settled nicely on the walls of a glass photography tank so that I could take some snaps of them. The adult moth fly that I photographed kept perfectly still, until I was finished. The larvae were another matter - they were full of beans! I observed them crawling around on the bottom of the photography tank, and they were not keen to cooperate as nicely as the adults for their portrait. I observed the larvae crawling underwater, much like a caterpillar, and at a rapid pace. This resulted in numerous out-of-focus pictures! I assume that the larvae were heading for the shelter of leaf litter or other debris, to reduce the risk of predation by being exposed. I used a microscope with a camera attachment so I could take some better shots.

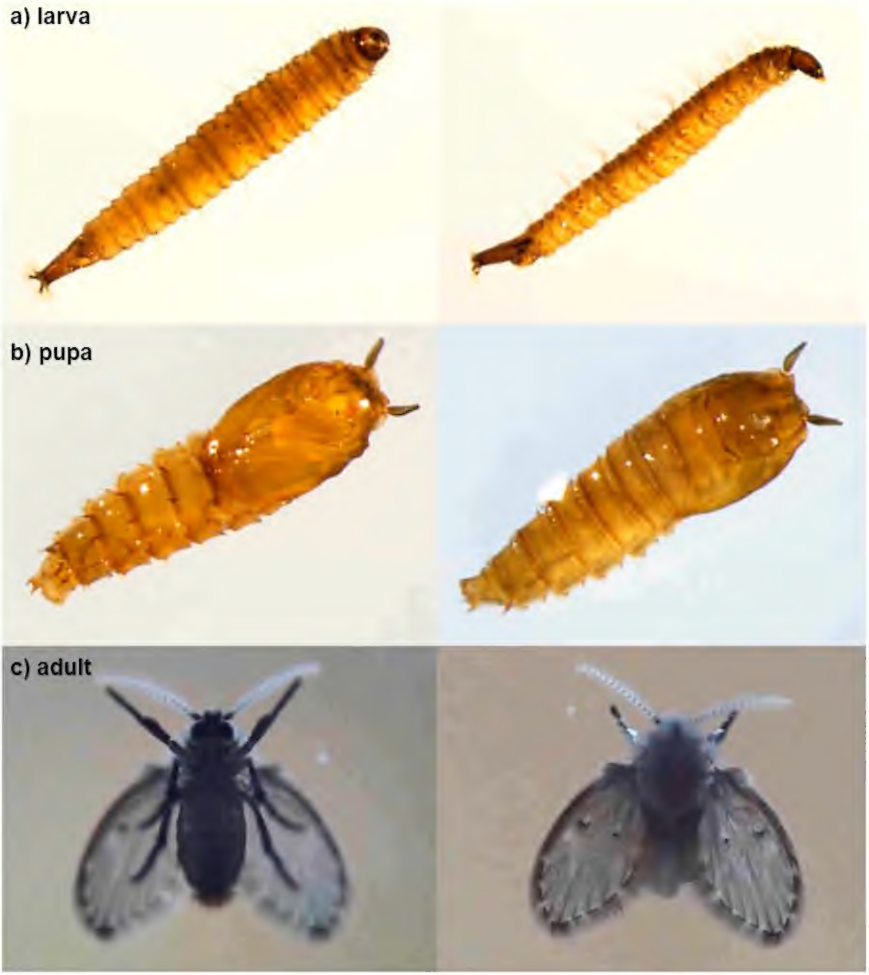

Fig. 3. Psychodidae: a) larva ventral and lateral views; b) pupa ventral and dorsal views; and c) adult ventral and dorsal views

Over the following weeks the moth fly larvae consumed much of the dead citrus bug material. I read stories about them on the internet, and it seems that people consider them a nuisance, asking for advice on how to get rid of them. On Wikipedia, they suggest removing “these pests” with “boiling water, bleach, or drain cleaner” (Wikipedia, 2013). In contrast, I found that the moth flies were providing a service - cleaning up the dead citrus bugs that I forgot about. I imagine that, in their ‘native’ (non-plastic bucket) habitat such as a pond, they may occasionally perform the same function, cleaning up dead insects - as their 'normal' food is decomposing organic material. Interestingly, the adults generally do not feed, and most only live for a day or two (Colless and McAlpine, 1991). I suggest that we leave these moth flies to live

in their natural habitat, and to keep our drains clean so that there is no need to kill off these cute little flies in the first place.

Although our moth flies appear to be mostly harmless, I should note that one subfamily of moth flies, the Phleobotominae, do feed as adults and are blood-suckers (Colless and McAlpine, 1991). Some of these species - found outside of Australia - transmit diseases, including leishmaniasis.

Australian taxonomic checklist (from Hawking et al. 2009)**:**

Order Diptera – family Psychodidae
- Subfamily Bruchomyiinae
  - *Nemapalpus australiensis* Alexander
- Subfamily Psychodinae
  - *Brunettia* 4 species
  - *Clogmia* 2 species
  - *Didicrum 2 species*
  - *Epacretron pulchrum* Duckhouse
  - *Notiocharis* 3 species
  - *Paratelmatoscopus* 5 species
  - *Peripsychoda* 7 species
  - *Psychoda* 21 species
  - *Rotundopteryx* 15 species (formerly *Pericoma*)
  - *Telmatoscopus* 10 species
  - *Threticus* 3 species
  - *Trichopsychoda montana* Satchell
- Subfamily Sycoracinae
  - *Sycorax australis* Duckhouse
- Subfamily Trichomyiinae
  - *Trichomyia* 19 species

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Photos Alisha Steward

Life history notes on the No-brand Grass-yellow, *Eurema brigitta australis* (Stoll, 1780) Lepidoptera: Pieridae - Wesley Jenkinson

The No-brand Grass-yellow is encountered in the Northern Territory, and coastal and sub-coastal regions from north-eastern Queensland into southern New South Wales. Migration of this species occurs throughout its range depending on regional rainfall, temperature and suitable availability of its host plants.

In Queensland the species is encountered in a variety of habitats where the host plants are established. This includes grasslands, woodland, eucalypt open forest and occasionally in suburban gardens where suitable habitat is nearby.

The adults fly close to the ground amongst low growing herbs and grasses. When disturbed they can fly quite rapidly and can be difficult to follow. During cloudy conditions they settle on low growing shrubs and ground cover and resume flight when sunny conditions return. Both sexes occasionally feed from a variety of small native and introduced flowers.

Whilst in flight, the adults can be very easily confused with other species of the *Eurema* genus, particularly *E. herla* and *E. laeta*. Voucher specimens are best for correct identification. The males of this species do not have a sex brand (as the name implies). In fresh specimens the adults can be separated from other *Eurema* spp. by the presence of two very faint pale yellow (or pinkish yellow) streaks along the costal margin towards the forewing apex as pictured. The species also has wet and dry season forms.

The sexes are quite similar in appearance. In comparison to the males, the females are slightly paler yellow with more extensive black scaling across the wings. The black margin along the hind wing is also generally broken and is less extensive towards the tornus.

The average wingspan for the adults pictured is 38mm for both sexes.

Eurema brigitta australis (No-brand Grass-yellow)
Images left to right: male, female, male underside, female underside

In January 2004 at Beaudesert, in south-eastern Queensland, a female was observed slowly fluttering around a host plant. Settling on the host plant with her wings closed, she curled her abdomen onto the upperside of a leaf and oviposited a single egg. This egg was kept for life history studies. Subsequently the larva was raised on a Fishbone Cassia (*Chamaecrista* sp.). The three confirmed host plants for this species are *C. concinna, C. maritima* and *C. nomame* (Moss, 2010).

This egg was pale yellow, spindle shaped with fine longitudinal ribs, approximately 0.5 mm wide x 1.5 mm high.

Freshly laid egg

When the first instar larva emerged the eggshell was consumed shortly afterwards. It was observed feeding during daylight hours and resting on the upperside of the host plant leaves. The later instars rested along stems of the host plant. The larva raised completed five instars and attained a length of 27mm.

1st instar larva

2nd instar larva

3rd instar larva

4th instar larva

5th instar larva lateral view

5th instar larva dorsal view

Pupa lateral view

Pupa lateral view

In captivity the pupa, measuring 16mm in length, was located below a stem of the host plant. It was attached with silk by the cremaster and a central girdle. The pupae occasionally have reddish-brown spots and markings as pictured.

The total time from egg to adult was three weeks, with egg duration of 3 days, larval duration 11 days and pupal duration of 7 days.

Within the new boundary of the Scenic Rim Regional Shire south of Brisbane, I have records of adults from November to April and one record for June. In this region the adults appear to be more numerous during the summer and autumn months. However, this relates to the timing of local rainfall triggering fresh growth of the host plants.

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Photos Wesley Jenkinson

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Getting more pixels - *Malcolm Tattersall*

In the last *Metamorphosis* of 2012, I compared image sizes and camera sensor sizes and concluded that most modern digital cameras will produce images of most insects which are satisfactory for most purposes. This time I will look at extending our range downwards, to get bigger images of tiny invertebrates close to us, and in the next issue I will talk about how to get better photos of larger but more distant subjects.

Wedding photographers have it easy: their subjects are all one to two metres tall and all one to ten metres away. By contrast, our invertebrate subjects can range from a tiny spider to an adult stick insect, or less than 0.2mm to more than 200mm in length, and 10cm to 10m or more away. That's an enormous range to cover - a size ratio of 1000:1 and a distance ratio of 100:1 - and our solutions this time have to be hardware rather than software.

Small and close

Let's start with the small, close subjects. Suppose you have seen a 5mm bug sitting on a leaf a metre away. Your photo from that distance with a general-purpose camera and lens combination will show it as a dot in the middle of the frame (50-100px wide in a 5000px image). Obviously, your first decision is to move closer, but there are two kinds of limits:

(1) The bug may take fright and jump away. Let's call this its *startle distance*. If the bug doesn't take fright, you keep moving in until …

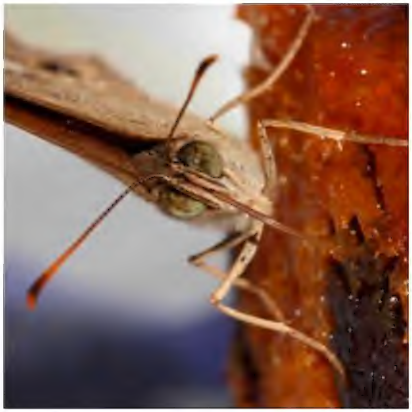
(2) The camera can't focus because it is too close to the subject, i.e. closer than its *minimum focus distance*. This will typically be 25–50cm from the sensor to the subject with everyday lenses. The distance from the front of the lens to the subject is called the *working distance*, and is another useful figure to keep in mind.

At the minimum focus distance you are at the point of *maximum magnification* of the lens and the image is as big as possible with your set-up. Maximum magnification is usually between 0.13 and 0.30. That is, the image on your sensor is 0.13 – 0.30 times the size of your subject, with 0.20 being about average. A rough calculation tells us – or a bit of experimenting shows us – that our 5mm bug becomes a 200px image. That's still not much use, so what can we do?

If you have a camera which doesn't take interchangeable lenses, you may have to go shopping for a new camera. If you don't want to go all the way to the price and bulk of a SLR, then look at point-and-click cameras with a large optical zoom range or the newish *bridge* category (http://en.wikipedia.org/wiki/Digital_camera will introduce you to the differences). However, some point-and-click cameras do accept close-up filters (see below) or clip-on macro lenses, so before you go too far with your research, ask about accessories for your present camera at your camera shop. Or you may be able to improvise, like an online friend of mine who gets great macro shots with a Panasonic DMC-FZ50. It has a 10x optical zoom to start with but he has extended its capabilities by fitting a philatelic magnifying glass into the frame of an old UV filter to make a +10 close-up filter – see http://www.flickr.com/photos/72842252@N04/ for some results.

This is an appropriate time to mention the difference between *optical zoom* and *digital zoom*. The former is a function of the lens and changes the size of the image on the sensor, and is extremely useful. The latter is a software function exactly analogous to cropping the image on your computer at home and, on the camera, it does nothing much except fool you into thinking you have a bigger image. See http://www.cambridgeincolour.com/tutorials/image-interpolation.htm for more on this subject.

If you have a SLR, then a *macro lens* is the best solution. Macro lenses should have a maximum magnification of 1.0 and Canon's three macros, of 60, 100 and 180mm, achieve that at their minimum focus distances of 0.2, 0.31 and 0.48m respectively. (This neatly illustrates the advantage of the longer lenses: you have less need to get within the startle distance. However, longer lenses are affected more by camera shake, so image stabilisation becomes particularly useful.) Some manufacturers' macros may have less magnification, e.g. 0.5, but will still provide a bigger image than a non-macro lens.



Orange Bush-brown, *Mycalesis terminus*, and cake, cropped from 3888 × 2592px to 1240 x 1240 for effect. Canon EOS 1000D, 100mm macro lens without extension tubes or CU filter. The butterfly was enjoying the Christmas cake so much that it let me get right down to minimum focus distance and take a dozen shots, even with the flash.

Alternatively, we can put a *close-up filter* on the front of a normal lens or insert *extension tubes* between the lens and the camera body to increase its maximum magnification. We can even do both, to achieve a maximum magnification up to perhaps 1.10. But be warned: they only offer their benefit at very short working distances, so many bugs will move off because you are too close. Also, they prevent the lens from focusing at long distances so you need to remove them for normal shooting.

Paper wasps, *Ropalidia revolutionalis* (about 8mm long), on nest. Canon EOS 600D, 15-85mm zoom lens at 85mm with a +2 close-up filter; 5184 x 3456px cropped to 2100 x 2800 to show wasps on nest, then cropped again to 480 x 600px to show (without taking up a whole page of the magazine) the level of detail achieved. A +4 close-up filter would have given me more magnification but I may have been stung for it.

Golden Mosquito, *Coquillettidia xanthogaster*. Canon 600D, 100mm macro lens with +2 CU filter, 5184 x 3456px cropped to 1330 x 1000.

Finally, we can use close-up filters and/or extension tubes with a macro lens for a maximum magnification of 1.5 or a little more. With any of this equipment, our 5mm bug is 800px or more wide – a vast improvement on the 200px we started with – so we can achieve satisfactory shots of close subjects as small as 3-5mm (jumping spiders, small flies and the like) and great detail with 10-20mm subjects. But other technical limits already begin to intrude in the sub-10mm range and more specialised gear is needed for the tiniest critters so I will stop here.

Photos Malcolm Tattersall

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Field Notes: Major extensions to the known distribution of the Bright Purple Azure, *Ogyris barnardi* (Miskin 1890) in Queensland (Lepidoptera: Lycaenidae) - *Kelvyn L. Dunn*

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During spring of 2011 and 2012, I investigated the distribution of the Bright Purple Azure butterfly, *Ogyris barnardi* in Queensland, in order to confirm the westernmost limits. I found that it extended much farther inland than currently believed. Prior to this investigation there had been relatively little survey of the butterfly fauna of western Queensland (see Dunn & Franklin 2010, online appendix), which by corollary raises the question as to the completeness of the limited distribution historically attributed to this species. Nonetheless, over many decades keen enthusiasts have regularly sought *Ogyris* (as a group) by determined searching, a selective process which might offset that inland knowledge deficit (for butterflies in general) to an extent. Indeed, given their general scarcity (and hard work required to obtain them) enhanced too by their brilliant hues, *Ogyris* butterflies have earned a status as gems among the Australian lycaenidae, with many rare species coveted and those reared for the cabinet proudly treasured. That the species, *O. barnardi*, was actually of limited and disjunct distribution in northern Australia, as generally thought, had hinged on published knowledge: Braby (2000) earlier presented a

synoptic range-fill map based on available records in museums and literature sources up to that time. All contributory factors considered then, the synoptic depiction was supposed to be reasonably accurate and thus likely inclusive of most of its distribution, approximating to the outer western limit of its occurrence.
Ogyris barnardi (Figure 1) inhabits mixed woodlands where the Grey Mistletoe, *Amyema quandang* (Loranthaceae) on which its larvae regularly feed, parasitises particular species of wattles (*Acacia*) (see Braby 2000 and references therein). The usual means of obtaining specimens of this uncommonly seen butterfly has been to rear adults from the juvenile stages (usually older larvae or pupae, found secreted in borer holes or under loose bark). Determined searching to this end has been responsible for most museum specimens collected to date and so less information is available about its seasonal flight period and the times of day that adults are active in those areas where it occurs. Encounters with the high-flying adults are often fleeting (making field identifications very difficult at best) and the regularity of their sighting in the field is a little unpredictable; on the balance then, those adults netted opportunistically are often in poor condition and so rendering them less suitable for retention. For this reason too, field sampling of adults is an infrequent practice as the lengthy time spent and labouring efforts made in the physically trying outback climate, where it lives, are not particularly rewarding to collectors.

In October and November, during the butterfly's spring appearance I systematically sampled mixed woodlands for evidence of the species whilst en route to the Gulf of Carpentaria in northern Australia, where I planned to seek out one or more other species. The butterfly is not readily found by random sampling: I examined numerous sites for various butterflies (not just this species) on my two trips (Figure 2), and of those inspected (Table 1), 22 locations (a rather small proportion by comparison) provided evidence of adults of *O. barnardi*. Where achievable, capture of one or more individuals was the means to confirm field identifications with certainty. That evidence obtained (Table 1) suggests that *O. barnardi* is widespread in the inland, albeit rather patchy in occurrence and confined to, and localised within, suitable habitat in western, central and northern Queensland. Indeed, the butterfly could extend farther west into the Northern Territory where Grey Mistletoe-infested woodland patches exist, and so, the remote border area could be the focus of those who wish to expand upon my study.

The butterfly looks drab in flight and, at such times, can be confused easily with other members of that genus. In general appearance, it closely resembles the Broad-margined Azure, *O. olane*, a species that is similarly sized and coloured, but one that seems absent from the acacia-dominated woodlands in the outback where *O. barnardi* exists. Importantly, *O. olane* does not utilise the Grey Mistletoe as a larval host in the wild, although a captive larva, proffered foliage, consumed this in one trial (Dunn 1997) and so an ancestral tolerance of a broader diet remains. Indeed, current evidence suggests the two species are host (and habitat) segregated, an adaptive

strategy that reduces competition for resources and one that probably drove their speciation eons ago. Yet, this divergence from its closest ally does not assure sole use of the larval host by that particular member of the genus. In fact, there is another species of *Ogyris*, but one more distantly related (unlike these two species, it has a differently shaped antennal club), that shares the same woodland habitat with *O. barnardi* and, at times, shares too that same mistletoe species as a host (but perhaps not the same individual plant). Hence, in some places in western Queensland, the species is sympatric with the Satin Azure, *O. amaryllis*, and where this situation arises, it represents an additional factor that confounds field identifications, short of handling. The latter species is a more widespread butterfly (its broader host range has enabled this) and one that looks very similar in flight (when in silhouette), albeit often (but not always) slightly larger. Obviously, the glistening azure blue upper-wings of *O. amaryllis* readily distinguish it from others but this telltale sign is rarely seen from below (the observers' usual position), and small males, when perched in shade with closed wings (the usual stance adopted), could easily be mistaken for an *O. barnardi* on *prima facie* evidence.

A helpful clue is the fact that adults of *O. barnardi* differ slightly in behaviour compared with *O. amaryllis*, which the trained eye may detect. They tend to patrol more locally and tenaciously perch on older wattle trees – especially favoured are those with many dead branches projecting into the canopy. Disturbing these may reveal a settled male, which otherwise could remain undetected during a passing inspection of habitat. From these high vantage points, the males dart out briefly to defend an aerial flight space, particularly one that overlooks one or more larval host plants. At such times, they may rapidly encircle those Grey Mistletoes growing nearby to seek out newly emerged females or to intercept visiting females inspecting the larval hosts for egg laying purposes and, particularly at certain times of day – late afternoon seems favoured – may pause to feed briefly at the mistletoe's flowers (when available and nectar enriched). During feeding bouts, which seemed loosely synchronised, I observed that several adults in succession would frequent one or two individual flowers, leaving other flowers close by on the same plant unattended. Much of the time though, adults did not feed but perched for lengthy periods, or routinely patrolled their haunts when intruding adults strayed into their airspace. At such times, a flurry of activity involving three or more adults could result and which often drew my attention to the presence of members of the genus at a location.

Provision of high quality identifications is paramount for rigour, yet at some locations, all adults evaded capture. Common reasons for this were (1) their sustained height in the canopy, (2) their rapid and evasive flight, and (3) the regularity of sightings at individual locations. In particular, a low abundance at the time or hour of my visit(s) sometimes made encounters infrequent and reduced opportunities to net passing adults. At the best of times, when adults were common and opportunities to net were duly increased, the quantity of snags (dead branches) on the older wattles

(the butterfly particularly favours these for perch sites) and festoons of creeping *Capparis*, equipped with net-hitching spines, often hindered the successful manoeuvring of a deep hoop-net attached to long poles. Those who have attempted to capture adults of *Ogyris* on a regular basis (not just occasionally) will recall that this is a time consuming task and, indeed, often a difficult one – particularly during midday hours when the sun is directly overhead – hence, an expectation of success at all sites is unrealistic. The inclusion of observations then (see Table 1) may raise doubt in the minds of some, as the species in this group can look very similar to the novice or advanced observer, even when equipped with field glasses. Nonetheless, I am experienced with this and other related species in Queensland, largely from survey work conducted on the Darling Downs as part of employment in the early 1990s (see fieldwork detailed in Dunn & Kitching 1994). On this accreditation, those field identifications deemed reliable comprise 'expert opinion' which is categorically 'almost certain' and a legitimate (albeit arguable) substitute, short of capture. These are marked 'Obs-only' to distinguish them from those verified (evidence-based) records (captures); I appreciate too that others may wish to gather more evidence at those sites concerned (where specimens were not obtained) and would encourage this. The 22 locations where I found the species on my two most recent field trips are listed from north to south (Table 1); those marked with an asterisk (*) are considerably beyond the range indicated by Braby (2000) and so now enrich the knowledge base. All distances were measures by road from the Post Office of the nearest township, and were calculated by vehicle odometer usually from the closest road marker (where these were available) to reduce instrumental error, and so are considered precise but variably accurate. GPS coordinates (and elevations) were obtained at each site with a hand-held trekking device, and the measured road distances to each were checked later on Google Earth (www.google.com/earth/index.html) to ensure agreement (that is, to within a kilometre) – there was minor disagreement for some though where large road distances were involved. Most locations were widely separated, often by hundreds of kilometres, but occasionally juxtaposed sites (variably within one kilometre of the other) received attention as well. For each of the juxtaposed locations the habitat was continuous and likely, the butterfly too. The GPS coordinates to the nearest minute are included (Table 1), but in all cases, the specimens are labelled more finely, whether that is to seconds or to one decimal place of a minute, as accuracy needs for each location dictated. Finally, the elevations inhabited by the butterfly ranged from about 70m to 540m, and all specimens examined corresponded with the geographically closest populations, namely the nominate subspecies to the east.

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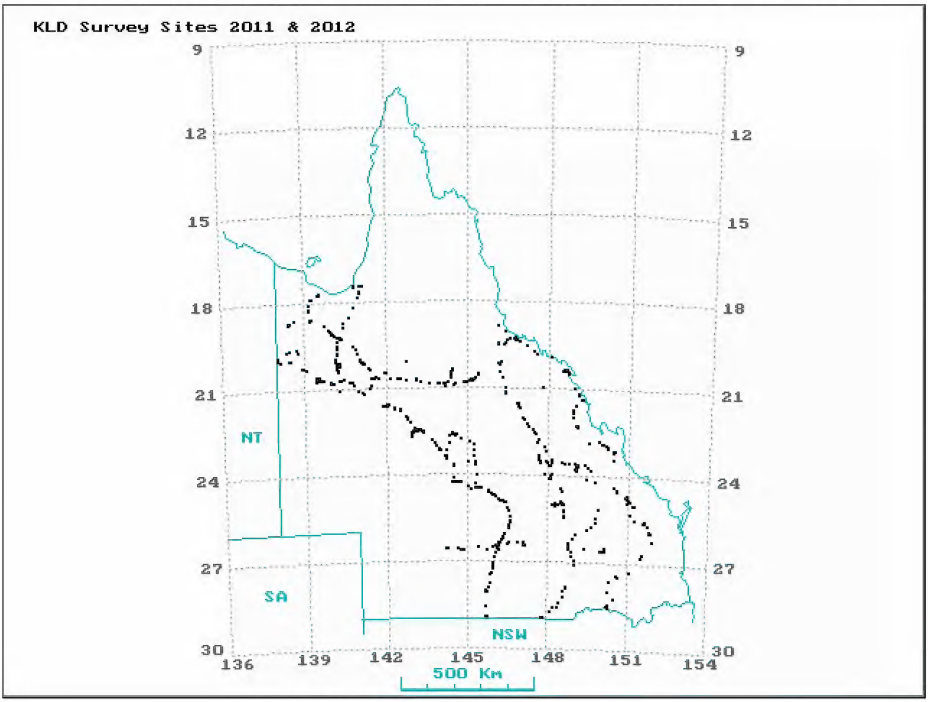
Figure 1. *O. barnardi* male at mistletoe flowers of *Amyema quandang*, 25km NW of Tambo, 02 Oct 2012. The arrangement of the eight black-edged, often smoky brown-tinged segments of the post-median band (which extends from the dorsum to the costa of the hind-wing, and which comprises five joined segments, with one (variably disjunct) segment at the dorsum and two more-or-less upright (disjunct) segments towards the costa) suggests the species involved. (In contrast, three or four slanted markings, situated increasingly distally along the hind-wing costa towards the apex, more abruptly end the continuation of the five joined segments of the post-median band in *O. olane*, the species it is most similar to). Although I offer this means as a useful guideline to help observers identify this species from field-gained photographs (and with a good probability of correctness too), I remind that the subsequent capture and examination of this adult confirmed its identification (KLDC).

Photo Kelvyn Dunn

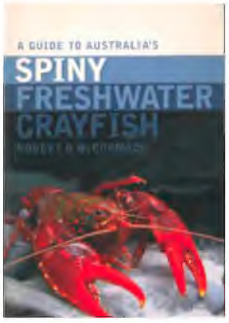
Table 1. The 22 author locations for *O. barnardi* in Queensland and associated information

Location	Geocode	Approx. Elev.(m)		Date	Time (AEST)	Abundance
Hazel Creek, 3.6km SSW Burke & Wills Roadhouse	19°15'S, 140°20'E	71	*	26 Oct 2012	0950-1045h	Many
58km NE of Camooweal	19°38'S, 138°31'E	238	*	20 Oct 2012	1210-1240h	Few (Obs only)
57km NE of Camooweal	19°39'S, 138°30'E	280	*	20 Oct 2012	1125-1200h	Few
48km E by S of Camooweal	20°00'S, 138°34'E	338	*	20 Oct 2012	1525-1600h	Few (Obs only)
47km E by S of Camooweal	20°00'S, 138°33'E	326	*	19 Oct 2012	1430-1445h	One
84km NNW of Cloncurry	20°03'S, 140°13'E	180	*	16 Oct 2012	1540-1640h	Few
Buckley River, 90km NW of Mount Isa	20°14'S, 138°57'E	312	*	19 Oct 2012	1330-1350h	Few
				20 Oct 2012	1655-1755h	Many
84km NW of Mt Isa	20°15'S, 139°01'E	329	*	19 Oct 2012	1200-1300h	Few
Gorge Creek, 18km E of Mt Isa	20°42'S, 139°39'E	335	*	02 Nov 2011	1300-1315h	One (Obs only)
1km WSW of Burra Range Lookout	20°43'S, 145°13'E	543		05 Nov 2011	0955-1005h	One (Obs only)
2km E by N of Prairie	20°52'S, 144°37'E	436		04 Nov 2011	1545-1635h	Few
Mt Walker Road, 11km S by E of Hughenden	20°56'S, 144°13'E	369	*	28 Oct 2012	1100-1110h	Few
7km S of Sapphire, at Gnech Rd	23°31'S, 147°44'E	268		09 Nov 2011	1400-1500h	Few (Obs only)
				10 Nov 2011	1115-1145h	One
3km E of Anakie	23°33'S, 147°46'E	264		10 Nov 2011	1115-1145h	One (Obs only)
54km N by W of Blackall	24°01'S, 145°21'E	278	*	26 Oct 2011	1435-1455h	One
39km E of Isisford	24°16'S, 144°48'E	239	*	03 Oct 2012	1300-1320h	One (Obs only)
16km W by S of Blackall	24°27'S, 145°20'E	290	*	03 Oct 2012	1030-1200h	Many
24km NW of Tambo	24°45'S, 146°06'E	395	*	26 Oct 2011	0920-1110h	Many (Obs only)
				02 Oct 2012	1400-1425h	Few
25km NW of Tambo	24°45'S, 146°06'E	397	*	02 Oct 2012	1250-1350h	Many
24km SE of Tambo, at Ivanhoe Station Rd	25°01'S, 146°26'E	476	*	01 Oct 2012	1620-1635h	One (Obs only)
'Highest point on range', 25km SE of Tambo	25°01'S, 146°26'E	477	*	01 Oct 2012	1530-1620h	Few
				02 Oct 2012	1030-1130h	Many
28km SW by S of Taroom	25°48'S, 149°38'E	239		14 Nov 2011	1240-1320h	Few (Obs only)

Figure 2. Author's butterfly survey sites in Queensland, spring 2011 and 2012



Book Reviews



McCormack, Robert B. 2012. ***A guide to Australia's spiny freshwater crayfish. CSIRO Publishing, Collingwood. Octavo, paperback, 235 pp. colour photographs, line drawings.***
$59.95 from the publisher.
Reviewed by Jonathan Marshall

I have long held a fascination and admiration for freshwater crayfish, particularly spiny crayfish from the genus *Euastacus* covered by Robert McCormack's new book. Australia is a hot-spot for world freshwater crayfish biodiversity and yet this diverse and endemic fauna is not recognised or appreciated by most Australians. The main reason for this, I am sure, is that there has been a conspicuous absence of natural history books about these animals to inform and intrigue the nation's many nature lovers. Until now,

much knowledge about Australian crayfish has been locked away in dry taxonomic papers in scientific journals, inaccessible and uninteresting to most outside a small community of freshwater scientists and amateur enthusiasts. This excellent new book from CSIRO Publishing makes a great leap forward towards introducing these beautiful and significant invertebrates to Australians and in doing so, I hope, igniting community conscience for the need to better conserve this unique biodiversity in the face of the multiple threats it currently faces.

Euastacus is the most diverse and perhaps most interesting Australian crayfish genus, with 50 described and at least four undescribed species ranging along the east coast from Cooktown in north Queensland to Wilsons Promontory in the south of Victoria. Some species are very large and conspicuous: at up to 3 kg *E. armatus* from the Murray River and southern tributaries is the largest, and *E. hystricosus* from the Maleny/Conondale Ranges region is Queensland's largest, growing to 1.2 kg (Figure 1). Many are also very colourful (Figure 2), with different species sporting fetching combinations of red, green, brown, black, white and blue, with variously developed spines and tubercles, often in contrasting hues. Others are small, inconspicuous and much less likely to be casually encountered. Most species have restricted, to very limited distributions, and very narrow habitat requirements. These characteristics make *Euastacus* a fine choice as a subject for a guide book such as this, which covers their anatomy, life history, ecology, identification, distribution and threats.

Figure 1. This *Euastacus hystricosus* from a stream in the Conondale Ranges is a member of Queensland's largest crayfish species and is threatened by illegal fishing. The spiny morphology characteristic of many members of the genus is clearly evident. (photo by Jonathan Marshall).

Book author Robert McCormack has over 20 years' experience as a commercial crayfish farmer in Australia and is secretary of the NSW Aquaculture Association, is a research associate with the Carnegie Museum in Pittsburgh, USA, and is prominent within the Australian Crayfish Project, which conducts biological studies of Australian waterways, collecting and identifying crayfish. Robert's passion for

freshwater crayfish is clearly evident from the enthusiasm of his writing in this book and his sharp observations of the biology and ecology of the various *Euastacus* species discussed.

Figure 2. *Euastacus sulcatus* from a stream in Springbrook National Park is perhaps the best known, and most colourful, of the Queensland *Euastacus*. This is a diurnally active species and often leaves the water to forage amongst moist leaf litter on the rainforest floor, where it loudly and aggressively hisses if disturbed. (photo by Jonathan Marshall)

The A5 sized, soft covered book is produced to a high standard, as one expects from this publisher. The many maps, figures and tables are clear and accurate. The numerous photographs of crayfish and their habitats are of a high standard and are clearly reproduced with accurate colour and at a size appropriate to their content.

The book aims to present the most up to date information on *Euastacus* taxonomy, identification, distribution and biology with the hope that increased interest and awareness will promote better conservation and management. It commences by giving a good overview of the necessary background to systematics, morphology and the general biology of the genus. There is a very nice table listing all 137 described Australian crayfish species in 10 genera with their distributions, plus a web site to check for new additions. This latter resource is very useful as new species are still being described – including several from the Queensland Whitsunday region just this year.

Euastacus species are then classified into three groups, which (although not described with this ecological term in the book) could be considered as guilds of species sharing broad morphological and ecological characteristics. This divide into 'giant spiny *Euastacus'*, intermediate *Euastacus'* and 'dwarf *Euastacus'* is made by the author pragmatically and for the purposes of the book. The rationale and justification for this grouping are quite well argued, but I was disappointed that no reference is made to the considerable information available on evolutionary relationships between *Euastacus* species derived from population genetics studies. It seems to me to be of great relevance to conservation management to know if the morphological and ecological

guilds recognised by the author represent distinct lineages in the evolution of the genus. Despite this, should the reader find a specimen to identify, the guild approach does without doubt assist greatly with the task. This is because of the fascinating observation by the author that within a single stream system, there can often be one species from each guild present, each occupying distinct ecological niches according to the guild it belongs to and its life-stage, but there are rarely multiple species present from the same guild. I am particularly interested in these observations because they infer a strong case for niche partitioning by competitive exclusion and differential environmental tolerances. These processes are common in some environments, such as rocky sea shores for example, but have rarely been demonstrated in stream ecosystems. The author's observations provide clear hypotheses ideal for scientific evaluation. PhD project, anyone?

The high species diversity of *Euastacus* is to a large extent a consequence of two phenomena: firstly, the physiological requirements of the genus for cool, moist environmental conditions, and secondly, the process of gradual aridification of the Australian continent over the past 40 million years. Suitable habitat for *Euastacus* has steadily contracted over this time and the genus is in fact a relic of the cool, wet Gondwanan forests that once covered our continent. For approximately the past five million years *Euastacus* populations derived from several widespread ancestors (perhaps representing the author's three guilds?) have been isolated in relic patches of cool wet conditions, usually on mountain tops along the east coast, and this has resulted in vicariant speciation to produce the many species we see today. Once again to my disappointment, this fascinating aspect of *Euastacus* biology is little mentioned in the book, and the several published studies which have presented this story are not cited (see further reading at the end of this review).

The main section of the book presents at least one nice colour photograph and a comprehensive description of each species, arranged in alphabetical order and for each including their habitat/activities, diagnosis, distribution, colour, breeding, conservation status and comments. An additional table and regional maps outline known species distributions. There is no taxonomic key presented, so species identification using the book relies on knowing where a specimen was collected and which of the three guilds it belongs to. Considering that the information necessary to generate a key is included in the species diagnoses, it is a missed opportunity that none was created for the book.

The penultimate chapter deals with threats to the viability of *Euastacus* populations. All Queensland species are protected from 'fishing' by the Fisheries Management Act but illegal harvesting is a major threat, especially to larger individuals of the giant species, pushing some close to extinction. According to the author, even some National Park Rangers are unaware that *Euastacus* in their park are protected by law! Let's hope they look at a copy of this book to put them straight. Climate change is an insidious threat to all species with limited capacity for dispersal and requirements for cool, moist conditions, with *Euastacus* particularly susceptible. Populations restricted

to mountain tops have nowhere to go if temperatures rise, but the author offers some hope for burrowing species as they may be able to retreat to their burrows as refuges from extreme temperatures. Habitat alteration is another broad threat, but fortunately many Queensland species are sheltered from this within National Parks. Anecdotal evidence suggests feral pigs actively seek *Euastacus* for food and indeed I have seen evidence of pig rooting in the vicinity of crayfish burrows within National Parks.

Finally there is a section on diseases and ectocommensals, including the cute little flatworms called temnocephala, which live on the exoskeleton of the crayfish without doing much harm and look like miniature inflated rubber gloves. Different *Euastacus* host unique temnocephala species, and they too are being studied to help understand the evolution of the Australian aquatic biota.

Overall, I very much like and recommend this book to anyone interested in Australian natural history, despite the few criticisms I have made. It provides a very good, if not comprehensive, overview of what is known of the genus and presents much that is new based on the keen observations of the author and his colleagues. It should be a valuable resource to students and researchers and I would be delighted to see ecological studies to formally evaluate some of the important anecdotal observations made by the author. Will it fulfill its ambition to improve *Euastacus* crayfish conservation and management? It is difficult to say, but as it is well presented, looks pleasant and includes ample information to encourage such an outcome, it does seem possible. Let us hope the relevant managers and policy makers take note, recognise the need and act to protect our beautiful and scientifically valuable *Euastacus* spiny crayfish.

Finally, I would like to thank CSIRO Publishing for kindly providing a copy of this book for review.

Ed.: A preliminary key by Robert McCormack is now available and was presented on the 6/02/2013 at the taxonomic workshop on aquatic invertebrates held at La Trobe University, Albury-Wodonga Campus.

Further reading:

Lowe K. et al. (2010). Physiological and behavioural responses to seasonal changes in environmental temperature in the Australian spiny crayfish Euastacus sulcatus. *Journal of Comparative Physiology B: Biochemical, Systemic and Environmental Physiology* **180**: 653-660.

Ponniah M. and Hughes JM. (2004). The evolution of Queensland spiny mountain crayfish of the genus Euastacus. I. Testing vicariance and dispersal with interspecific mitochondrial DNA. *Evolution* **58**: 1073-1085.

Ponniah M. and Hughes JM. (2006). The evolution of Queensland spiny mountain crayfish of the genus Euastacus. II. Investigating simultaneous vicariance with intraspecific genetic data. *Marine and Freshwater Research* **57**: 349-362.

Shull HC. et al. (2005). Phylogeny and biogeography of the freshwater crayfish Euastacus (Decapoda: Parastacidae) based on nuclear and mitochondrial DNA. *Molecular Phylogenetics and Evolution* **37**: 249-26.

The Moths of Victoria Vol. 4 - *Reviewed by Peter Hendry*

The fourth in a series of booklets aimed at depicting every moth species occurring in Victoria, volume 4 covers the Geometridae subfamilies Geometrinae and Oenochrominae. The booklet contains 36 pages, each specimen being represented by a photo of a pinned specimen. Many of the species are represented by photos of live specimens as well. There are a few photos of larvae as well as a photo of the eggs of *Oenochroma vinaria* and the pupa of *Chlorocoma vertumnaria*. Accompanying the booklet is a CD with over 390 pages of information in which over 350 of these deal with the Geometrinae and Oenochrominae while the others include updates to previous volumes, a checklist of volume 4 and an index of volumes 1 to 4. There are many clues on separating one species from another in those difficult to tell apart species, including a key to the difficult *Chlorocoma.* Several life cycles are also depicted.

The Victorian Geometrinae is represented by about 45 species along with several unnamed species. This represents about 24% of the Australian Geometrinae. The Oenochrominae is represented in Victoria by about 87 species plus several unnamed species which is about 36% of the Australian Oenochrominae. This superb booklet along with the previous volumes is a must for anyone with even a passing interest in the Australian moth fauna.

As many of the moths occur Australia-wide it will prove to be a very useful tool in identifying the Geometrinae and Oenochrominae well beyond the borders of Victoria. It must be noted also that the out of print volume 1 has been reissued with several additional species and new images of previous species.

Moths of Victoria is priced at $12 per volume plus postage; those interested can contact the Victorian Entomology Society at vicmoth@entsocvic.org.au and request an order form.

REPORTS

Report on the day at Peter Hendry's identifying moths in the family Crambidae – *Peter Hendry*

On Saturday the first of December 2012 several moth enthusiasts gathered at the Sheldon home of Peter Hendry to try and identify the moths in their collections belonging to the Crambidae family. Not all were collectors, Graham McDonald from Mudgeeraba is a keen moth photographer ably supported by his wife Beth. Peter Kuttner is an Artist who hosts "The Biodiversity of Tamborine Mountain" web site (http://www.biodiversity.com.au/PKu.htm) . Also among the non-collectors were

Dennis and Leah Tafe of Victoria Point. Dennis has a Masters in Science and a PhD in Marine Biology and runs Dr. Tafe Safaris (http://www.drtafesafaris.com/)

There was much socialising and many moths were named, several from families other than the Crambidae. A Bar-B-Q was put on in the evening and catered for by my wife Bev and sister- in-law Val. A light trap was also run in the evening. All in all, it was a very enjoyable afternoon and evening.

Some of the Moths:

Fig. 1 *Styphlolepis agenor*

The largest Crambidae on display, with a wing span of 60mm, was *Styphlolepis agenor* (Fig. 1) taken by myself west of St George. Named in 1915 by A.J. Turner from two specimens received from Mr. W.W. Froggatt who noted that the larvae bore into the stems of *Capparis mitchelli*, feeding for about twelve months and finally killing the tree. *Styphlolepis* belongs to a small subfamily, Midilinae, containing seven species.

Fig. 2 *Hednota argyroeles*

An interesting *Hednota* from the subfamily Crambinae was *Hednota argyroeles* (Fig. 2); Wes Jenkinson has two specimens from Myall Park Botanic garden near Glenmorgan and I have two from Policeman's Creek near Rubyvale. The Ibold website indicates this to be a northern species but Meyrick who named it in 1880 described it from a specimen collected near Brisbane. Of interest from the light trap was a geometrid in the subfamily Oenochrominae, *Phrataria transcissata* (Fig. 3). This was a first for me, as I had never collected it before. On a recent trip to West Bellthorpe, several of those present had photographed or collected another member of this genus *P. replicataria.*

Fig. 3 *Phrataria transcissata*

Thanks to all who attended and made the day memorable.

Vale Barry Kenway

"Bazza", as he was known to his mates, was born in Toowoomba on 13th July 1934 and spent much of his life in that city, aside from his schooling in Warwick and teaching career in Brisbane. Initially he taught Physical Education followed by Biology and German.

I met Baz in the mid-80's when we went on various excursions and camps with the Queensland Naturalists' Club. A fitter man you wouldn't find in the bush, probably due to his participation in competition squash (was in the Queensland State team) and various other sports.

His interest in dragonflies and damselflies was engendered while working as a Waterwatch co-ordinator after his retirement from teaching. He contributed much of his time and knowledge to his beloved Toowoomba Field Naturalists' Club in excursions, presentations and articles in the club newsletter.

He died on Friday 18th January last, at the age of 78, after a long illness. His passing is an enormous loss, not only to family and friends but to colleagues, club members and his wider associates. He is survived by wife Nancy, three daughters and a son.

John Moss

In a Corinda Garden

Unfortunately this is the last of the series of articles which the late Murdoch De Baar had left with me…(Ed.)

Some butterfly views - *Murdoch De Baar*

The Indigo Flash, *Rapala simsoni* (Horsfield) fam. Lycaenidae, can present as we might normally expect (Fig. 1), or as a larva difficult to see (Fig. 2), or as a bird might see it from an overhead view (Fig. 3). These three views were taken on Native Mulberry *Pipturus argenteus* (Urticaceae) foliage.

Larvae of the Purple Azure, *Ogyris zosine* (Hewitson) fam. Lycaenidae, go on a bivouac from the ant nest to mistletoes above, with the sugar ants, *Camponotus claripes* Mayr group, in attendance (Fig. 4). This activity starts just after it gets quite dark, as both the butterfly larvae and the ants shun daylight or torch lights.

A Common Pencilled-blue *Candalides absimilis* (Felder) fam. Lycaenidae, rests a while and displays its pencilled wings (Fig. 5) thus why it is named a Pencilled-blue.

Fig. 1 A normal view of an adult Indigo Flash

Fig. 2 A camouflaged view of an Indigo Flash larva. Ed.: Unfortunately the resolution in this old photograph is not as good as today's capabilities but readers should be able to see the green larva and marvel at its remarkable mimicry of the buds of the host plant!

Fig. 3 An overhead view of an Indigo Flash adult

Fig. 4. A bivouac commences as Purple Azure larvae are attended by the sugar ant entourage.

Fig. 5. A Pencilled-blue displays pencilled wings.

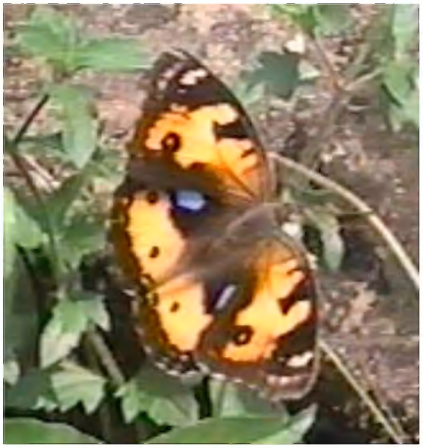
Photos Murdoch De Baar

LETTERS

4th December 2012

Received my magazine today, and wish to make a passing comment on the butterfly from Vientiane, depicted on p. 26, and which was listed as 'probably a Blue Pansy (*Junonia orithya wallacei*).'

The adult depicted is actually the Yellow Pansy (*Junonia hierta*). It is a common and attractive species in SE Asia which has similar behaviour to *J. orithya* (well known to readers in Australia) but which can be recognised by the pale areas along much of the forewing underside as well as some hindwing patterns which are characteristic of it. The upperside (not shown) is very distinctive.



I photographed this very same species in Vientiane, Laos, about 10 years ago, along with 11 other species of butterfly which were in its company. The Yellow Pansy was flying about the fountain near the centre of town, around which a flower garden had been planted. On 5 July 2002 they fed at Lantana between the hours of 1300-1330h (local time), which was when I passed by and took the opportunity to do some video photography. When I returned to the fountain later that day (1725-1740h) there were only 4 species feeding by that time (and the Yellow Pansy was not one of them). In my experience these kinds of butterflies (*Junonia* spp.) seem to retire early (sometime in mid-afternoon in the tropics) and so become less active by this time of day - this applies in Australia as well to an extent. Nonetheless, one of the four species feeding in late afternoon (*Pachliopta aristolochiae*) was not seen earlier, and the habits of that particular group explain that quite readily. Collectively this later afternoon visit brought the total to 13 species, all of which were seen feeding at the Lantana shrubs. I might have seen more species if I had lingered longer or arrived in the morning, but there were plenty of other things to do during my stay in Laos.

Regards Kelvyn Dunn

****

22nd January 2013

A couple of months ago there was a fantastic article in the Sydney Weekend Australian Newspaper with a full page colour spread showing a magnificent photo of an Australian "Peacock Spider". It was truly amazing - a spider with iridescent scales just like a butterfly. I 'googled' it and found some even more amazing footage (see

link http://www.abc.net.au/catalyst/stories/3160792.htm) showing it's 'Peacock-like' behaviour - displaying a colourful tail and dancing for the female! This story is the sort of thing one really needs to see video of. I showed Angus Stewart when I went to the Native Garden Design Conference in Melbourne 10th Nov and suggested that we have more on Gardening Australia about the little bugs and things in gardens - the way Densey Clyne used to do on Burke's Backyard. He said it was a good idea and last weekend I was very happy to see that at least half the show was dedicated to native insects and their associations with native plants. How fantastic!

I was also thinking about the article in the latest magazine on Aphids and how the only way the author found he could get rid of them on his orange tree was to use ant poison. It reminded me that I read somewhere that some species of Aphis are host specific on a native plant. This is useful information because if a native plant is amongst the Citrus and other food plants, it has the advantage of attracting the Aphid that won't touch your food plant, but *will* attract the predators to the area!

Did you see on the Oct. Gardening Australia a fantastic 5min story about how a commercial lettuce grower in South Aust. had an entomologist, Glennys Wood make the excellent recommendation to plant low, dense indigenous plants (in this case, Saltbush) around the poly-houses to suppress weeds that were harbouring pest insects that were spreading disease to the lettuce. The native plants were so successful at attracting insect predators and suppressing weeds that the grower has reduced spraying chemicals by 95%! They are now growing native plants under the benches in the poly-houses as well as outside! This is the sort of article that helps people connect the native plants with our Australian ecologies and also helps explain why we need to protect bushland. As people are growing more food in home gardens lately articles such as this CSIRO study (insect predators more abundant with bushland around) also help show how important it is to look after the butterflies and other invertebrates!

I also just wanted to tell you about a book I bought recently - "Spiders: Learning to Love Them", CSIRO. What an interesting book and a great read! I must say it really is causing me to look much more carefully at spiders. So much wonderful scientific information too! I highly recommend it! It inspired me to write a little poem and photograph a tiny Jumping Spider I found last week.

Kind regards *Maree McCarthy* B.Env.Sc., Hort. Cert.

You Asked

Confused Nymphalids!

Club member Jon Middleweek of Albany, WA found a female Common Crow (*Euploea core*) paired with a male Varied Eggfly (*Hypolimnas bolina*) in his butterfly house in January. He would like to receive comments from "experts".
Photograph by Lata S. Wright of Lata Photography.

What invertebrates made these? – *Ross Kendall*

I found these constructions on a young eucalypt out Warwick way in early January and really have no hypotheses as to the builders. Can anyone enlighten me?

Butterfly and Other Invertebrates Club Programme

Leisurely ramble along the creek and water bug collection
This excursion follows on from this edition's creature feature. We will look out for aquatic invertebrates, but will also look for butterflies and other invertebrates that live alongside the creek. If time permits, we can walk to the dam and try to collect some water scorpions.
When: From 10am, Saturday **23rd March, 2013**
Where: Lois and John Hughes' property, Mt Cotton - address provided on RSVP
RSVP: Lois Hughes 3206 6229
Bring: Your lunch and a plate to share for afternoon tea if you wish to stay on. You will also need a hat and sunscreen, and if you plan to sample in the creek then you will need shoes that can get wet/muddy.
A dip net, forceps, pipettes and white viewing trays will be available for collecting and observing water bugs.

Trivia Night – 20th April, 2013 – See enclosed flyer

AGM – 27th April, 2013 – See enclosed flyer

Planning Meeting – 11th May, 2013

DISCLAIMER

The magazine seeks to be as scientifically accurate as possible but the views, opinions and observations expressed are those of the authors. The magazine is a platform for people, both amateur and professional, to express their views and observations about invertebrates. These are not necessarily those of the BOIC. The manuscripts are submitted for comment to entomologists or people working in the area of the topic being discussed. If inaccuracies have inadvertently occurred and are brought to our attention we will seek to correct them in future editions. The Editor reserves the right to refuse to print any matter which is unsuitable, inappropriate or objectionable and to make nomenclature changes as appropriate.

ACKNOWLEDGMENTS

Producing this magazine is done with the efforts of:

- Those members who have sent in letters and articles
- Lois Hughes who provided the cover painting
- Daphne Bowden who works on layout, production and distribution
- John Moss, Dr. Jon Marshall and Dr. Alisha Steward for scientific referencing and proof reading of various articles in this issue of the magazine
- Printing of this publication is proudly supported by Brisbane City Council

We would like to thank all these people for their contribution.

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PO Box 2113
RUNCORN Q. 4113

Next event – Leisurely ramble along the creek and water bug collection - Saturday 23rd March 2013 - See BOIC Programme for details